



Economic Inequality and Pond Ecosystem Health

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INTRODUCTION

Urbanization occurs as a result of a social shift from a rural to an urban way of life. During urbanization, natural spaces are altered to accommodate growing populations within a particular environment¹. During the 1800's, industrialization was taking root in Brooklyn, New York, prompting the creation of Prospect Park (PP). PP was commissioned out of necessity to preserve and cultivate green spaces within a rapidly industrializing sector². Since PP's inception, humans have been utilizing the green space and altering the natural environment within the park, therefore making it critical to question the extent of this human impact². Pollution, industrialization, and socioeconomic disparities influence the quality of the ecosystems within public parks¹, hence it is important to investigate how these factors have done so.

Hypothesis: We made several predictions surrounding the relationship between factors influencing Prospect Park. We hypothesized that:

- Areas with higher economic status would associate with a higher Water Quality Index (WQI), less litter, less particulate matter, and a greater abundance of birds.

METHODS

Four ponds were chosen at PP based upon their proximity to surrounding neighborhoods of varying socioeconomic status³.

Site	Neighborhood	Median Income in Dollars
Lull Water	Prospect Lefferts	39,000
Vale of Cashmere	Prospect Heights	41,000
Lower Pond	Park Slope	108,000
Upper Pond	Park Slope	120,000

Bird Observation and ID: Bird observation surveys were conducted once at each pond site for for a duration of 10 minutes. Observation locations were chosen within a 3 meter distance from the perimeter of the pond and covered a 50 meter radius. This consisted of a primary observer, who surveyed the area with binoculars, and a primary recorder, who recorded the birds seen by the observer.

Water Quality: To determine water quality, tests were conducted using La Motte kits for Dissolved Oxygen, pH, Turbidity, Nitrates, and Phosphates. For each test, at least four trials were conducted using a sample of water collected in a jar or bucket.

Litter Survey: At each site, a litter survey was conducted for 10 minutes. During the duration of the survey, all team members collected non-recyclable, recyclable, and biodegradable litter found within a 5 meter radius of the research site⁴.

Air Quality: To measure air quality, we used the Airbeam paired with the Aircasting app and walked around the ponds for 10 minutes. Once time elapsed, we took data from the app on particulate matter in the area ($\mu\text{g}/\text{m}^3$).

RESULTS

Site	Chemical Test	Individual WQI	Overall WQI
Lull Water	DO	27	57
	pH	60	
	Turbidity	80	
	Nitrate	96	
	Phosphate	49	
Vale of Cashmere	DO	98	66
	pH	41	
	Turbidity	5	
	Nitrate	96	
	Phosphate	60	
Lower Pond	DO	67	68
	pH	41	
	Turbidity	76	
	Nitrate	96	
	Phosphate	47	
Upper Pond	DO	98	85
	pH	62	
	Turbidity	58	
	Nitrate	96	
	Phosphate	96	

Range	Quality
90-100	Excellent
70-90	Good
50-70	Medium
25-50	Bad
0-25	Very Bad

Fig. 1-- A Water Quality Index provides a single number that expresses overall water quality based on several parameters. The *Field Manual for Water Quality Monitoring*⁵ was used to calculate the WQI at each site.

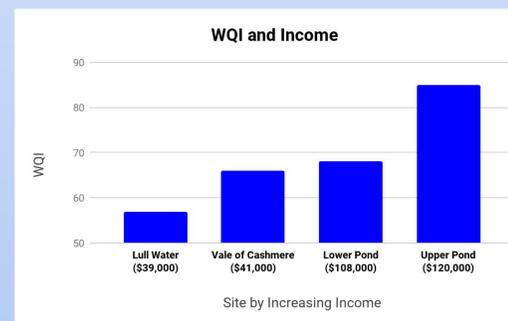


Fig. 2-- This graph depicts the direct relationship between the Water Quality Index at each site and the median income of the surrounding neighborhood.

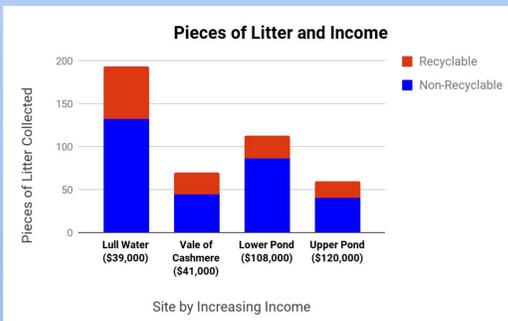


Fig. 3-- The graph above shows the pieces of litter collected (sorted by recyclable and non-recyclable) at each site.

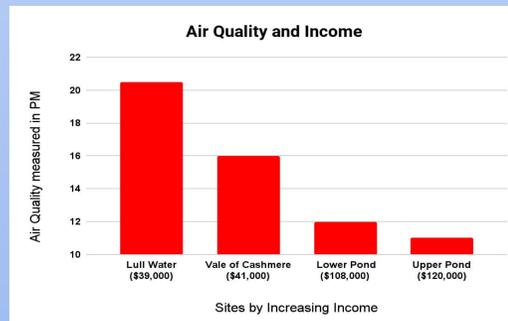
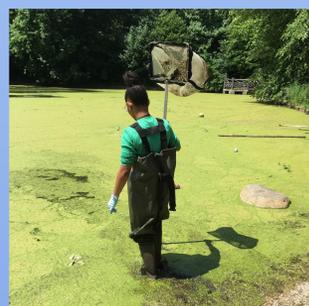


Fig. 4-- This graph depicts the inverse relationship between air quality measurements at each site and the median income of the surrounding neighborhood.



Pic. 1-- Water sample collecting



Pic. 2-- Testing water quality



Pic. 3-- Dabbling!

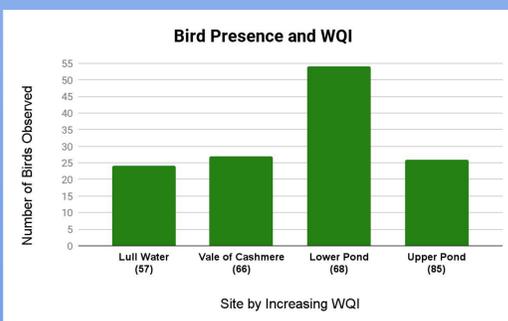


Fig. 5-- The graph shows that there is no relationship between the Water Quality Index and the bird abundance at a given site.



Fig. 6-- This graph depicts a general decreasing trend in litter as the Water Quality Index increases at a given site.

DISCUSSION

Economic Inequality and Pond Ecosystem Health

We can conclude that economic inequality does relate to water quality, concentrations of litter found, and air quality. This is displayed by Fig.1 which shows the lowest WQI (57) found at Lullwater, with (median income of \$39,000³) and the highest WQI (85) at Upper Pool (medium income \$120,000). Fig. 2 shows that there is an inverse relationship between median income and the amount of litter found at each pond site. This figure supports our hypothesis regarding income and the amount of litter found at each site, as it shows that the amount of litter found at Lull Water is almost double the amount found at Upper Pond. Additionally, our prediction that as median income increases, levels of particulate matter will decrease is also supported by our data. Fig. 3 shows that there is a direct relationship between socioeconomic status, in terms of median income, and the WQI of a pond ecosystem.

Water Quality Index and Litter/Bird Presence

Fig. 4 shows that there is no relationship between bird presence and WQI. We thought that because water is a vital resource to birds, an unhealthy pond ecosystem would directly affect bird presence. Potentially, there is no relationship between bird presence and WQI because factors such as canopy cover or noise pollution that affect bird behavior were not taken into account in our study. However, as shown in Fig. 5, WQI does relate to litter found at each site and hence supports our hypothesis. As WQI increases, the amount of litter observed at each site decreases. Fig. 5 shows that a 57 WQI associates with a litter count of nearly 200 trash items, while an 85 WQI associates with a litter count of less than 60 items.

Further Discussion

Today, on a local and global level, our environment is suffering a variety of changes. It is extremely important to start discussions about the changing state of our environment and the factors that have created such changes. Additionally, we need to discuss how economic inequality should not affect a person's access to healthy green spaces and water. People living in neighborhoods with a high median income should not have all the benefits of cleaner, greener parks. Tragedies such as the water crisis in Flint, Michigan display the need to emphasize and demand environmental justice for all class levels of our society.

REFERENCES

- McKinney, M. L. (2002). Optimizing Urbanization, Biodiversity, and Conservation. *BioScience*, 52(10),883-890.
- Prospect Park Alliance (2017). *Park history slideshow*. Retrieved from <https://www.prospectpark.org/learn-more/park-history-slideshow/>.
- WNYC (2008-2012) Median Income Across the US
- Clarke, M. J., & Maantay, J. A. 2006. recycling in all of New York City's neighborhoods: Using GIS to develop the REAP index for improved recycling education, awareness, and participation. *Resources, conservation and recycling*, 46(2), 128-148.
- Mitchell, M. K. 1986. *Field Manual for Water Quality Monitoring: An Environmental Education Program for Schools*. Thomson-Shore, Inc. 12-17.

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